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In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

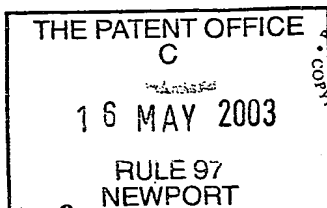
Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed 

Dated 13 February 2004

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APPLICANT: Julian G. BALSDON  
APPLICATION NO.: New U.S. Application  
FILED: March 11, 2004  
FOR: SEALING ARRANGEMENT  
ATTORNEY DOCKET NO.: 118920



19MAY03 E808270-1 D01097  
POL/7700 0.00-0311378.4

# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
Newport  
South Wales  
NP10 8QQ

1. Your reference PAT/AT/3142

2. Patent application number  
(The Patent Office will fill in this part)

16 MAY 2003

0311378.4

3. Full name, address and postcode of the or of each applicant (underline all surnames)

ROLLS-ROYCE plc  
65 BUCKINGHAM GATE  
LONDON  
SW1E 6AT  
GREAT BRITAIN

00003970002

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

GREAT BRITAIN

4. Title of the invention SEALING ARRANGEMENT

5. Name of your agent (if you have one)

MR V J BIRD  
INTELLECTUAL PROPERTY DEPT WH 58  
ROLLS-ROYCE plc  
PO BOX 3  
FILTON  
BRISTOL  
BS34 7QE

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Patents ADP number (if you know it)

00065789006

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

YES

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d))

## Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form 0

Description 5

Claim(s) 3

Abstract 0

Drawing(s) 2

+ 2 4M

10. If you are also filing any of the following, state how many against each item.

Priority documents 0

Translations of priority documents 0

Statement of inventorship and right to grant of a patent (Patents Form 7/77) YES

Request for preliminary examination and search (Patents Form 9/77) YES

Request for substantive examination (Patents Form 10/77) NO

Any other documents (please specify) NO

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

V J BIRD

15 MAY 2003

12. Name and daytime telephone number of person to contact in the United Kingdom ADAM TINDALL 0117 979 4623  
adam.tindall@rolls-royce.com

### Warning

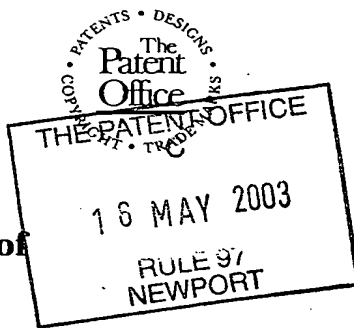
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- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
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Patents Form 7/77

Patents Act 1977  
(Rule 15)



The Patent Office

Cardiff Road  
Newport  
South Wales  
NP10 8QQ

Statement of inventorship and of  
right to grant of a patent

1. Your reference PAT/AT/3142

2. Patent application number  
(if you know it)

16 MAY 2003

0311378.4

3. Full name of the or of each applicant ROLLS-ROYCE plc

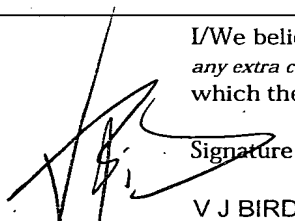
4. Title of the invention  
SEALING ARRANGEMENT

5. State how the applicant(s) derived the right  
from the inventor(s) to be granted a patent

BY VIRTUE OF THE INVENTORS' TERMS AND CONDITIONS OF  
EMPLOYMENT

6. How many, if any, additional Patents Forms  
7/77 are attached to this form? NO  
(see note (c))

7. I/We believe that the person(s) named over the page (and on  
any extra copies of this form) is/are the inventor(s) of the invention  
which the above patent application relates to.

  
Signature  
V J BIRD

Date  
15 MAY 2003

8. Name and daytime telephone number of  
person to contact in the United Kingdom  
ADAM TINDALL 0117 979 4623  
adam.tindall@rolls-royce.com

Notes

- a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- b) Write your answers in capital letters using black ink or you may type them.
- c) If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.
- d) When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.
- e) Once you have filled in the form you must remember to sign and date it.

**Patents Form 7/77**

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

JULIAN GLYN BALSDON  
24 ANSON CLOSE  
SALTFORD  
BRISTOL  
BS31 3DY

Patents ADP number (if you know it):

06124184002

Patents ADP number (if you know it):

**Reminder**

**Have you signed the form?**

Patents ADP number (if you know it):

## SEALING ARRANGEMENT

The invention relates to a sealing arrangement.

The sealing arrangement can be employed to maintain a seal in any suitable pressure vessel including but not limited to a gas turbine engine.

In a particular problem addressed by the invention it is required to maintain a seal between two relatively moveable parts which form part of a barrier between a region of high fluid pressure and a region of low fluid pressure. One example where such a seal is required is between platforms of a stator vane in a gas turbine engine.

Conventionally adjacent faces of adjoining stator vane platforms are formed with a groove in the axial direction of the engine. A flat sealing strip is inserted into the groove thereby presenting a convoluted flow path and a reduced flow area for fluid to leak from the high pressure side to the low pressure side.

It is apparent that while the leakage is reduced, there may be a significant leakage flow, thereby reducing the overall efficiency of the engine.

Alternatively the sealing strip may be formed as a wedge and forced into the grooves such that the leakage path past the abutting faces of the adjoining platforms is substantially reduced.

This method has significant demerit as it increases the overall rigidity of the stator vane assembly. If relative movement of the stator vanes is required, by way of non limiting example, in order to alter the radial location of the stator vanes during operation of the engine, then such a configuration will limit the degree to which this can be achieved.

In accordance with the present invention there is provided a sealing arrangement for sealing a leakage gap between at least two relatively moveable parts which are adjacent to each other in a flow path between a region of high fluid pressure and a

region of low fluid pressure, at least one groove being provided along each adjacent face of the relatively moveable parts, wherein the sealing arrangement further comprises at least two resilient sealing strips, each strip having a portion formed along at least part of its width to locate in the at least one groove, the remaining portion of each of the at least two sealing strips having a substantially flat surface, the at least two sealing strips being configured such that in operation their substantially flat surfaces abut each other.

Preferably the at least two sealing strips are formed such that the portion shaped to locate in the at least one groove is of arcuate cross-sectional configuration.

Alternatively the at least two sealing strips are formed such that the portion shaped to locate in the at least one groove is of "C" shaped cross-sectional configuration.

Preferably the at least two relatively moveable parts form part of a seal disposed around a substantially cylindrical pressure vessel. Alternatively the at least two relatively moveable parts form part of a seal disposed around a substantially frusto-conical pressure vessel.

Preferably the pressure vessel is a gas turbine engine.

The invention is a means for sealing between two relatively moveable parts including, but not limited to, platforms of stator vanes and seal liner segments in a gas turbine engine.

The invention and how it may be carried into practice will now be described in detail with reference, by way of example, to embodiments illustrated in the accompanying figures, in which:

Figure 1 illustrates part of a stator vane assembly incorporating a sealing arrangement in accordance with the present invention;



Figure 2 shows an enlarged view of one embodiment of a sealing strip for use in a stator vane assembly incorporating a sealing arrangement, and;

Figure 3 shows an enlarged cross sectional view of part of the stator vane assembly shown in Figure 1.

Figure 4 shows a cross sectional view of part of a stator vane platform comprising an alternative embodiment of the sealing arrangement in accordance with the present invention.

The stator vane assembly 10 presented in Figure 1 forms part of a conventional gas turbine engine well known in the art and will not be described in this specification beyond that necessary to gain an understanding of the invention.

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The stator vane assembly 10 comprises an annular array of stator vanes 12, each of which is formed with a platform 14 which is located on the engine (not shown) by any suitable means. A groove 16 is formed into the face 18 of each platform 14 which is adjacent to a circumferentially adjoining platform 14. Each of the grooves 16 is aligned substantially in the axial direction of the engine shown at "A". A sealing strip 20 is located in each of the grooves 16 and is substantially of the same length as the platform 14. The sealing strips 20 are formed such that at least part of their width is shaped to locate in the groove 16, the remaining portion of the sealing strip 20 being substantially flat.

In operation a surface indicated at "B" on the platform 14 will be exposed to a higher fluid pressure than a surface indicated at "C" on the platform 14.

A sealing strip 20 is presented in Figure 2. It comprises a resilient member formed along at least part of its width such that the portion shaped to locate in the groove 16 is arcuate or "C" shaped, hereafter referred to as the formed portion 22. The remaining portion of the sealing strip is substantially flat, hereafter referred to as the flat portion 24.

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An enlarged view of a cross section showing detail of the formed portion 22 of the sealing strips 20 located in the platform grooves 16 is presented in Figure 3. The flat portions 24 of the sealing strips 20 are in communication with each other substantially along their length, although it will be appreciated that the formed portion 22 may be a loose fit in the groove 16 and that adjacent flat portions 24 may be spaced apart when the engine is not in operation.

In operation the flow of fluid between the high pressure surface side "B" and the low pressure surface side "C" the sealing strips 20 and the platforms 14 will force the flat portions 24 of the adjacent sealing strips 20 together, forming a seal. High pressure fluid entering the volume partially enclosed by the formed portion 22 will cause the formed portion 22 to expand into the groove 16, thereby forming a seal.

It will be appreciated that the greater the difference between the high pressure fluid acting on surface "B" and the low pressure fluid acting on surface "C" then the greater the force pressing the flat portions 24 together and deforming the formed portions 22, and hence providing a better seal.

It will be appreciated that the formed portion 22 may be any shape which fulfils the same function, such as an "E" or "W" shaped cross-sectional configuration. Such a "W" or "E" shaped portion 26 is shown in figure 4.

It will be appreciated that the sealing strips 20 will also provide an adequate seal if they are aligned substantially at an angle to the axial direction of the pressure vessel.

It will also be appreciated that the invention may be employed in any suitable application, including but not limited to, the compressor and turbine sections of a gas turbine engine and seal liner segments of a gas turbine engine.

It will be appreciated that figures 3 and 4 may, in addition to that described above, represent an enlarged view of a seal interface between adjacent seal liner segments.

The configurations shown in the accompanying figures are diagrammatic. The design of the vanes, the vane platforms, the grooves and the sealing strips may vary between designs. Likewise the configuration and relative positioning of the described components may differ in different embodiments of the invention.

**CLAIMS**

- 1 A sealing arrangement for sealing a leakage gap between at least two relatively moveable parts which are adjacent to each other in a flow path between a region of high fluid pressure and a region of low fluid pressure, at least one groove being provided along each adjacent face of the relatively moveable parts, wherein the sealing arrangement further comprises at least two resilient sealing strips, each strip having a portion formed along at least part of its width to locate in the at least one groove, the remaining portion of each of the at least two sealing strips having a substantially flat surface, the at least two sealing strips being configured such that in operation their substantially flat surfaces abut each other.
- 2 A sealing arrangement as claimed in claim 1 wherein the at least two sealing strips are formed such that the portion shaped to locate in the at least one groove is of arcuate cross-sectional configuration.
- 3 A sealing arrangement as claimed in claim 1 wherein the at least two sealing strips are formed such that the portion shaped to locate in the at least one groove is of "C" shaped cross-sectional configuration.
- 4 A sealing arrangement as claimed in claim 1 wherein the at least two sealing strips are formed such that the portion shaped to locate in the at least one groove is of "E" shaped cross-sectional configuration.
- 5 A sealing arrangement as claimed in claim 1 wherein the at least two sealing strips are formed such that the portion shaped to locate in the at least one groove is of "W" shaped cross-sectional configuration.

- 6 A sealing arrangement as claimed in any preceding claim wherein the at least two relatively moveable parts form part of a seal disposed around a substantially cylindrical pressure vessel.
- 7 A sealing arrangement as claimed in any preceding claim wherein the at least two relatively moveable parts form part of a seal disposed around a substantially frusto-conical pressure vessel.
- 8 A sealing arrangement as claimed in claim 6 or claim 7 wherein the at least two sealing strips are aligned substantially in the axial direction of the pressure vessel.
- 9 A sealing arrangement as claimed in claim 6 or claim 7 wherein the at least two sealing strips are aligned substantially at an angle to the axial direction of the pressure vessel.
- 10 A sealing arrangement as claimed in any preceding claim wherein the at least two relatively moveable parts are platforms of a stator vane.
- 11 A sealing arrangement as claimed in any preceding claim wherein the at least two relatively moveable parts are seal liner elements.
- 12 A sealing arrangement as claimed in any preceding claim wherein said sealing arrangement forms part of a gas turbine engine.
- 13 A sealing arrangement as claimed in any one of claims 1 to 11 wherein the pressure vessel is a gas turbine engine.
- 14 A sealing arrangement substantially as hereinbefore described with reference to the accompanying drawings.

- 15 A pressure vessel comprising a sealing arrangement substantially as hereinbefore described with reference to the accompanying drawings and in accordance with any one of claims 1 to 11.
- 16 A gas turbine engine comprising a sealing arrangement substantially as hereinbefore described with reference to the accompanying drawings and in accordance with any one of claims 1 to 11.

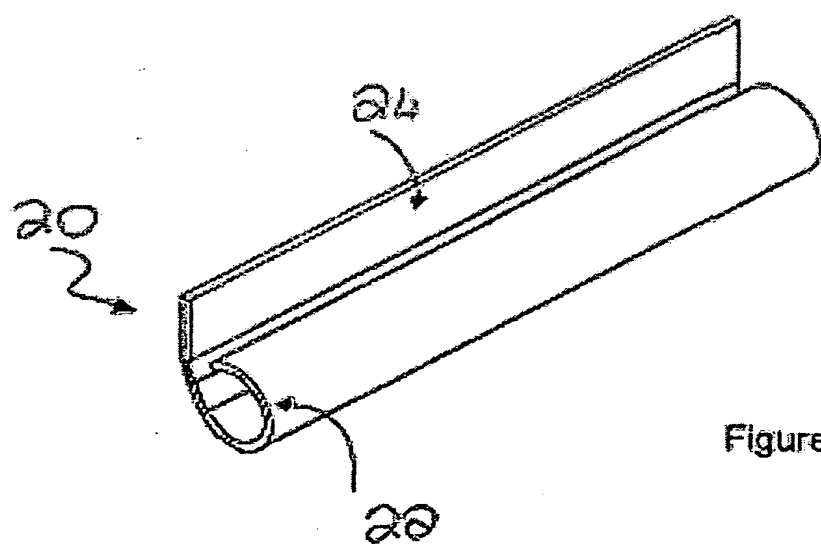
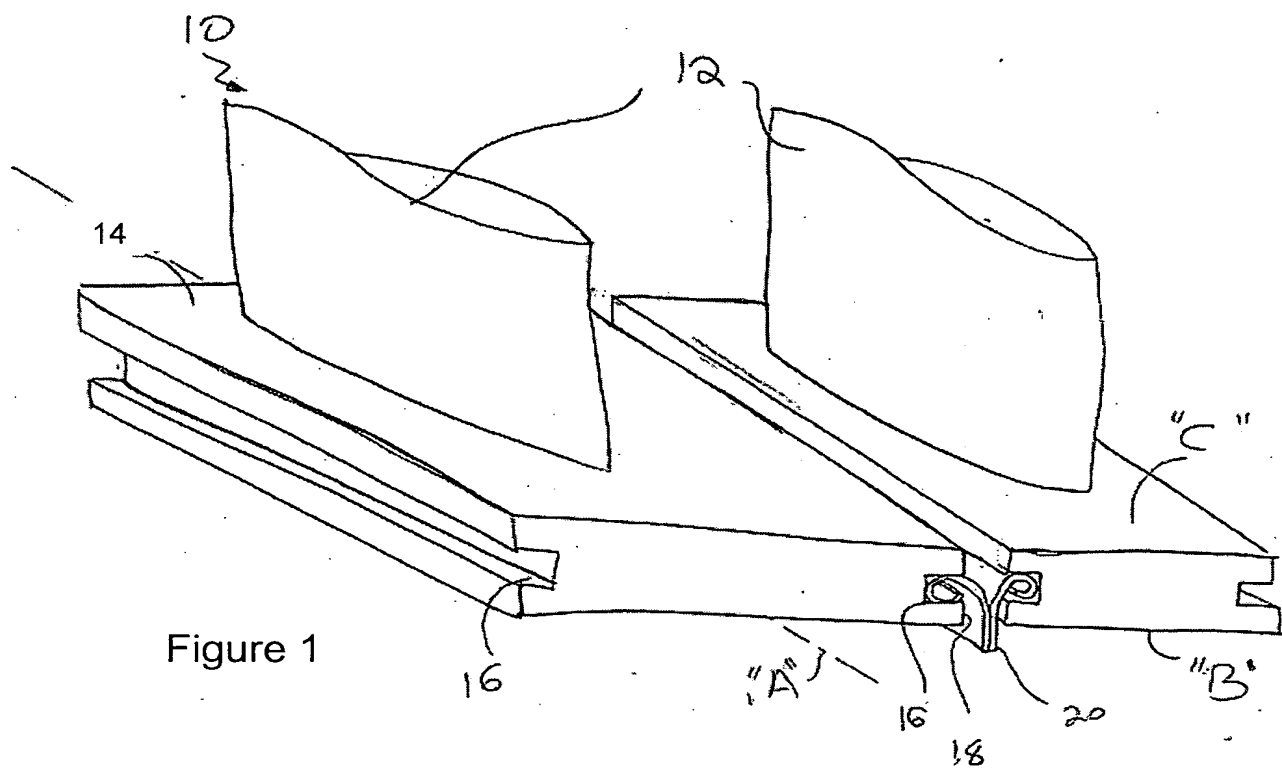


Figure 2

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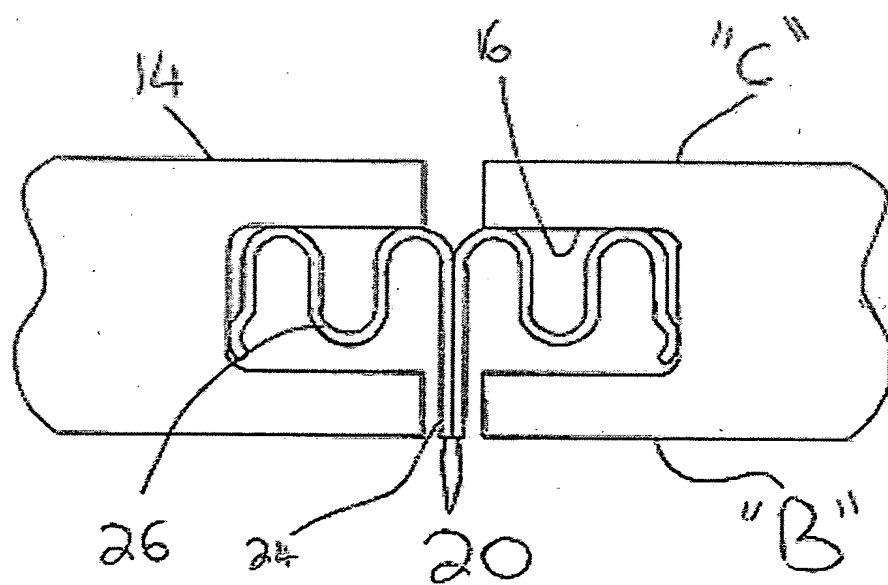
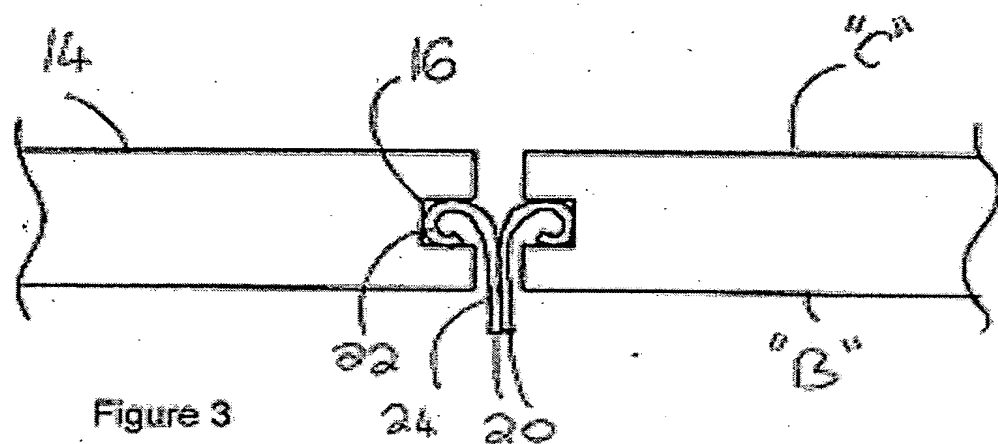


Figure 4

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